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An implicit pictorial methodology for measuring and retraining smokers' reactivity to pictures of pros and cons of smoking: development protocol

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ABSTRACT

Objectives: The last decades, there has been increased interest in the application of implicit pictorial tasks (e.g. Visual Probe Task (VPT), Approach Avoidance Task (AAT)) to target addictive behaviors. The present study reports on the development of implicit pictorial assessment and modification tasks aimed at targeting cognitive biases underlying motivational smoking-related cognitions (i.e. the pros and cons of smoking).

Methods: Respondents were adult daily smokers not motivated to quit smoking within six months (N = 33). A cross-sectional four-step approach using qualitative and quantitative strategies was utilized to identify and match pictures of pros and cons of smoking.

Results: The study resulted in 30 pro-con picture pairs matched on valence, arousal and complexity: the picture pairs were used to develop a VPT assessment and training for attentional biases and an AAT assessment and training for approach-avoidance biases.

Conclusions: The developed measurement and training tasks will be used to explore and change cognitive biases regarding pros and cons of smoking. This may consequently influence the perceived pros and cons of smoking and yield positive effects with regard to the motivation to quit smoking.

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1. Introduction

The last decades, there has been increased interest in the application of implicit or indirect tasks in the field of addictive behaviors. In general, these tasks are built on the idea of dual-process models that a person's behavior is determined by implicit cognitive processes as well as by explicit cognitive-motivational processes [1–5]. Explicit processes are deliberate and require conscious awareness, while implicit processes are associative and can be triggered automatically [3]. Moreover, implicit processes are subject to the incentive salience of cues which may result in cognitive biases such as attentional bias [6–9] and approach bias [8,10,11]. Implicit pictorial tasks (see [Methods](#) for more details) are often used to explore cognitive biases. The tasks then include

pictures from a category of interest (e.g. addiction) that are contrasted with pictures from a reference category (i.e. non-addiction related) in order to assess differences in reactivity to the pictures from these two categories. If a person responds faster to the pictures from the category of interest, this is then considered as an indication of bias towards this category. Proper matching of pictures from different categories is therefore essential, because picture features, such as complexity, can influence the reactivity [12]. The importance of this kind of stimuli standardization preceding to task development has already been emphasized in previous studies [13,14]. Following these initiatives, the present study was conducted to identify and match pictures before developing implicit pictorial measurements and trainings to target perceived pros and cons of smoking in smokers who are unmotivated to quit smoking.

New methods to target smokers who are unmotivated to quit smoking within six months (about 75% of all smokers) are essential to further decrease the burden caused by smoking [15–17]. In general, the determinants of a lack of motivation in smokers are well studied. Smokers are, for instance, assumed to be unmotivated

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to quit smoking when they perceive more pros than cons of smoking [18–20]. Studies have demonstrated a clear pattern in which the pros of smoking overrule the cons in the stage of non-motivation [21–23]. Furthermore, it has been demonstrated that addressing the pros and cons of smoking in non-motivated smokers is more effective than addressing, for instance, self-efficacy [24]. The percentage of smokers who remain unmotivated to quit, however, remains high; suggesting that current treatments may not be sufficiently appropriate for them [25]. It is, moreover, suggested that smokers who are not motivated to quit smoking avoid reading, talking and/or thinking about their risk-behavior [25] and that they may be less receptive for persuasion methods. Implicit pictorial methods – which are less persuasive – may be alternative promising approaches.

The present manuscript describes the development of an implicit pictorial tool for measuring and modifying implicit biases that may be underlying the pros and cons of smoking. The steps taken to generate a set of relevant stimuli as well as the procedure followed for matching pictures from the pros category to pictures from the cons category on valence, arousal and complexity are reported.

2. Methods

Ethical approval for this study was obtained from the Medical Ethics Committee of the Atrium Hospital in Heerlen, the Netherlands (13-N-03).

2.1. Design and respondents

The study was a cross-sectional study consisting of four steps using qualitative and quantitative strategies in order to generate a set of picture pairs representing matched pros and cons of smoking (with the aim to explore cognitive biases towards pros of smoking, compared to the cons of smoking). Respondents were daily smokers (the number of respondents differed per step, see next paragraph for more details per step) in the age of 18–65 years who were not motivated to quit smoking within six months. The social networks of our researchers were consulted for recruiting respondents.

2.2. Procedure and questionnaires per step

The identification of pictures representing the pros and cons of smoking and the matching of the pictures was done in several steps.

2.2.1. Step I: generating a list of pros and cons of smoking

The first step was to generate a list of common pros and cons of smoking. This was done by consulting the literature and conducting interviews with 20 smokers. The interviews were taken by a researcher from our department and included questions on demographic variables (gender; age; educational level), smoking related factors (number of cigarettes smoked per day; age of starting smoking; quit-attempts) and the motivation to quit smoking. Furthermore, the respondents were asked about their perceived pros and cons of smoking in the form of open-ended questions. All respondents filled in a consent form in which they agreed with the terms of participation, confidentiality was assured and they were explained they could refrain from participation when they wanted to.

2.2.2. Step II: picture search

In the second step the researchers searched for pictures that may represent the pros and cons of smoking that were identified in the first step. Istock, a Web source for stock images, was used to

select the pictures.

2.2.3. Step III: picture interpretation

In the third step, the pictures from the second step were presented to a small group of smokers ($N = 5$) who were asked to give their interpretation with regard to the content of the pictures. The goal of this step was to gain insight into whether the pictures were interpreted as meant by the research team. This step consisted of an online assessment in which the pictures were presented and each picture was followed by an open-ended question asking the respondent what the picture represents according to them. The results were used by the research team to exclude pictures that were not interpreted as the pro or con they were supposed to represent.

2.2.4. Step IV: valence, arousal and complexity ratings

In the fourth step, the remaining pictures (37 cons and 30 pros of smoking) were rated online by 33 respondents on valence (displeasure/pleasure), arousal (calm/excitement) and complexity (very simple/very complex) conform another task development study aimed at identifying alcohol stimuli for non-drinkers [26]. The pictures were shown one by one for five seconds on a computer screen, followed by a rating scale asking the respondents to rate the picture on valence, arousal and complexity. *Valence* (pleasure/displeasure), *arousal* (excitement/calm) and *complexity* (very simple/very complex) were measured using the affective rating system devised by Lang et al. [27]. The valence scale asked respondents to rate the extent to which the presented picture made them happy/unhappy on a nine-point scale (1. very unhappy; 5. neutral; 9. very happy). The arousal scale asked the respondents to rate to what extent the presented picture made them feel calm/excited on a nine-point scale (1. very calm; 5. neutral; 9. very excited). The complexity scale asked respondent to what extent they would find it easy/difficult to describe the presented picture in detail on a nine-point scale (1. very easy; 5. neutral; 9. very difficult).

2.2.5. Additional questions

The questionnaire also included other variables. *Demographic and smoking related variables* assessed gender, age and the number of cigarettes smoked per day. *Nicotine level of dependence* was assessed by six items asking about the number of cigarettes smoked per day (ten or less (0); 11–20 (1); 21–30 (2); more than 30 cigarettes (3)), when the first cigarette is usually smoked after awakening (within five minutes (3); in 6–30 min (2); in 31–60 min (1); after 60 min (0)), which cigarette is seen as most difficult to give up (the morning cigarette (1); another cigarette (0)) and three questions that were answered with yes or no (whether one smokes more in the morning, whether one also smokes when being sick and whether one finds it difficult to smoke in places where it is prohibited to smoke). The questions were based on an abbreviated Fagerström test [28,29]. The sum score was used in the analyses (0 = not dependent, 10 = very dependent).

2.3. Format of the implicit pictorial tasks

The implicit pictorial tasks we aim to develop in this study are based on the Visual Probe Task and the Approach Avoidance Task, tasks already used in addiction research and also recently applied for retraining purposes [11,30–34]. The best picture matches that will be identified in the present study will be used in the Visual Probe Task as well as in the Approach Avoidance Task for measuring as well as retraining cognitive biases with regard to pros and cons of smoking.

2.3.1. The Visual Probe Task

The Visual Probe Task is a measure of attentional bias. The Visual Probe Task was first introduced by Macleod et al. [35] and is nowadays widely used to measure attentional processes in substance abuse [30,32–34]. In currently used versions of the tasks, respondents are shown two pictures (or other stimuli, e.g. words) side by side on a computer screen. Each picture pair contains a picture for the stimuli of interest (e.g. drug related pictures or in this study: the pros of smoking) and a picture from the reference category (e.g. neutral pictures or in this study: the cons of smoking). After a short interval the cues disappear and are replaced by a probe (mostly an arrow pointing up or down). Respondents are asked to identify the place and direction (up or down) of the probe as soon as possible by using the buttons on the computer keyboard. Faster responses to probes replacing drug-related cues indicate attentional bias towards drug-related cues compared to neutral cues. This task can be used as a measurement of attentional bias as well as a retraining. In the measurement the probe appears behind the neutral cue in 50% of the cases and behind the drug-related cue in the other 50% of the cases. In the training task the probes appear behind the neutral cue in 100% (or 90%) of the cases to shift the attention away from the drug-related cues.

2.3.2. The Approach-Avoidance Task

The Approach-Avoidance Task is a measure of approach-avoidance bias. The version we propose is based on the Approach Avoidance Task used in alcohol-related studies [11,31]. In the current version of the task alcohol-related cues are shown in portrait or landscape format. The participants are instructed to respond (push or pull using the computer keyboard) to picture format (e.g. they were instructed to push when the picture was placed in landscape format). The assignment they receive with regard to the picture format is counterbalanced: half the participants receive the instruction to pull the landscape pictures and the other half receives the instruction to push the landscape picture to exclude biases. This task can be used as a measurement as well as training. In the measurement version of the Approach Avoidance Task the drug-related cue and the neutral cue are equally placed in the pull or push format. When participants are faster in pulling drug-related cues when they are in the pull-format compared to when they are in push format we can speak of an approach bias. In our tasks the drug-related cues will again be replaced by the pros of smoking and the reference category will be the cons of smoking (same as in the Visual Probe Task).

2.4. Study analyses

Descriptive analyses were used to describe the sample characteristics with regard to gender, age, smoking behavior, nicotine dependence, and perceived pros and cons. Mean valence, arousal and complexity scores were calculated for the pictures representing the pros and the pictures representing the cons, separately. Paired sample *t*-tests were performed in order to compare the valence, arousal and complexity scores of the pictures representing the pros of smoking with the scores of the pictures representing the cons of smoking. It is expected that pictures representing the pros of smoking are perceived as significantly more pleasant by smokers (i.e. a significantly higher score on valence) and less arousing compared to the pictures representing the cons of smoking. 'Complexity' referred to the visual characteristics of the picture and is thus not necessarily related to the content, therefore, we do not expect significant differences on this variable. Next, independent sample *t*-tests were conducted in order to explore differences between males and females. These were exploratory analyses in order to gain insight into whether a different approach is needed for

males and females. The hypotheses were tested on a two-sided significance level (alpha) of 5%. Finally, a separate analysis was conducted in order to identify the best pro-con picture match. The match was based on the difference score between pictures from the pros category and pictures from the cons category. The valence score of a picture in the pros category was compared to each of the pictures in the cons category, a difference score between that particular picture and each of the pictures in the other category was calculated per individual. The same was done for the arousal and complexity scores. Then the difference scores per picture pair were averaged over all respondents. This resulted in mean (over all individuals) difference scores for each pro-con picture pair on valence, arousal and complexity. A sum score over the valence, arousal and complexity difference scores was calculated. Valence is considered as most important for matching [14,36] and following the methods used by Pulido et al. [26], we used the following formula to calculate the sum scores:

$$\text{Sum score} = (\text{valence} * 2) + (\text{arousal} * 1) + (\text{complexity} * 1)$$

3. Results

3.1. Sample characteristics

A total of 33 respondents rated the pictures on valence, arousal and complexity. The mean age of the respondents was 32 (SD 11.00) years, 63.6% were female. Of all respondents, 84.8% smoked ten cigarettes or more. On average, the respondents smoked 13 (SD 5.19) cigarettes a day and they had a mean FTND score of 3.45 (SD 2.06).

3.2. Step I and step II: generating a list of pros and cons & relevant pictures

Table 1 shows the list of pros and cons of smoking as derived from the literature and from interviews with 20 smokers (step I). Moreover, the table shows the number of pictures identified per item (step II). The researchers selected 39 pictures representing the cons of smoking and 31 pictures representing the pros of smoking. It should be noted that for some items no pictures were found (the tables shows that there are zero pictures for these items) because they appeared too difficult to represent in a picture. These items were: nice taste; distraction/having something in hands; smokers' image; bad for taste; dependence; negative for others and shame.

3.3. Step III: picture interpretation

The online interpretation study resulted in the exclusion of two pictures from the cons of smoking category and one picture from the pros of smoking category. The two pictures with regard to the cons of smoking, both showed old hands for representing the item 'brown fingers/old skin' but they were both interpreted as 'being dead' or 'lying in state' or a 'stop sign'. The picture from the pros category was supposed to represent relaxation, but was interpreted as smelling something nice.

3.4. Step IV: valence, arousal and complexity ratings

Table 2 shows the ratings on valence, arousal and complexity for the pros category as well as for the cons category. In this sample of smokers, the pictures from the pros category were rated as significantly more pleasant than the pictures from the cons category ($t = -11.02$; $p < 0.001$). The pictures representing the pros of

Table 1

Perceived pros and cons based on literature and interviews and the number of pictures per item.

Perceived pros		Perceived cons	
Items	Number of pictures ^a	Items	Number of pictures ^a
Nice taste	0	Unhealthy	8
Social bonding & cosines	8	Not good for condition	4
Stress reduction/relaxing	15	Respiratory problems/coughing	8
Distraction/having something in hands	0	Bad for taste	0
Smokers image (cool)	0	Negative influence on appearance	8
		- Teeth	
		- Brown fingers	
Weight control	8	Costs	5
		Dependence	0
		Smell	6
		Negative for others	0
		Shame	0

^a Note: for some items no pictures were sought (the tables shows that there are zero pictures for these items) because they appeared too difficult to represent in a picture. The items in question were: nice taste; distraction/having something in hands; smokers' image; bad for taste; dependence; negative for others and shame.

Table 2

Mean valence, arousal and complexity ratings by smokers (N = 33) per picture type.

	Pros of smoking (30 pictures)		Cons of smoking (37 pictures)		t-test	P-value
	Mean (SD)		Mean (SD)			
Valence	7.19 (1.22)		3.50 (1.14)		−11.02	<0.001
Arousal	4.19 (1.87)		5.42 (1.03)		2.99	0.005
Complexity	3.04 (1.31)		3.51 (1.61)		1.98	0.056

smoking were also rated as significantly more calming compared to the pictures representing cons ($t = 2.99$; $p = 0.005$). The difference in perceived complexity was not statistically significant ($p > 0.05$). To check whether our sample of 33 respondents had enough power, post hoc power analyses were conducted. Based on $N = 33$; $\alpha = 0.05$, two-tailed and a medium effect size (Cohen's $d = 0.5$), the power ($1 - \beta$) was 0.795.

3.5. Gender differences

Table 3 shows the valence, arousal and complexity ratings, stratified by gender. There was no significant difference between males and females on the ratings of valence, arousal and complexity of neither of the pros pictures nor on the cons pictures ($p > 0.15$ for all three parameters and with regard to both pictures types).

3.6. Picture matching

The matching procedure resulted in 30 matched pictures pairs. Of the 30 matched picture pairs only 16 were used in the final VPT task and 15 pairs were used in the final AAT task: the inclusion of these pairs was based on the ability to modify the pictures to portrait, landscape formats without losing the content.

3.6.1. Task development

The final implicit pictorial tasks – which were based on the earlier explained VPT and AAT task – were created by including the picture pairs as identified in the present study. The aim of the tasks will be to explore attentional and approach-avoidance biases with regard to the pros and cons of smoking. Of both tasks, a measurement version as well as a retraining version is developed.

3.6.1.1. The Visual Probe Task. A Visual Probe measurement task is developed with the goal to assess whether smokers who are unmotivated to quit smoking are biased towards the pros of smoking compared to the cons of smoking. The Visual Probe training task is developed to modify this bias towards the cons of smoking in order to change the perceived pros/cons of smoking and to increase the motivation to quit smoking. The 16 identified picture pairs are divided into four sets of four pictures (set A, B, C and D), because some sets need to be used for the measurement, others for the training and others for the post-measurement. The pre-measurement consists of 96 measurement trials (each trial shows a picture pair) and includes set A and set B: thus, eight picture pairs are used in the pre-measurement and they are repeated 12 times (=96 trials). The training includes set B, C and D and consists of 576 training trials. Set A and set D are used in the post-measurement in order to include untrained pictures (set A) and trained pictures (set D). The latter is done in order to measure generalized effects (does

Table 3

Valence, arousal and complexity ratings of pictures representing pros of smoking and pictures representing cons of smoking, stratified by gender.

		Pros of smoking (30 pictures)		t-test	P-value	Cons of smoking (37 pictures)		t-test	P-value
		Mean (SD)				Mean (SD)			
Valence	Males (N = 12)	7.06 (1.37)		−0.50	0.62	3.52 (0.78)		0.10	0.93
	Females (N = 21)	7.28 (1.15)				3.48 (1.33)			
Arousal	Males (N = 12)	3.66 (1.66)		−1.23	0.23	5.11 (1.06)		−1.33	0.19
	Females (N = 21)	4.49 (1.95)				5.60 (0.99)			
Complexity	Males (N = 12)	3.24 (1.37)		0.69	0.50	3.59 (1.50)		0.22	0.83
	Females (N = 21)	2.92 (1.29)				3.46 (1.70)			

the training also influence new pictures of the same category?). The pre-measurement also includes exercise trials before starting the measurement. Furthermore, the pre-measurement as well as the training include priming blocks in which smoking related pictures were shown to introduce the smoking context in which the pictures need to be seen. All trials in the Visual Probe start with a fixation cross for 500 ms. The fixation cross is followed by the presentation of two pictures (a pair) for 1000 ms: when the pictures disappear an arrow pointing up or down appears behind one of the pictures. The respondents then need to identify the direction of the arrow. In the pre- and post-measurement the arrow appears behind the pictures of the pros category in 50% of the trials and behind the cons pictures in the other 50% of the trials. In the training the arrow only appears behind the cons of smoking in order to shift smokers' attention to the negative consequences of smoking.

3.6.1.2. The Approach-Avoidance Task. The Approach Avoidance Task consists of a pre-measurement, training and post-measurement and includes fifteen pairs which are divided into three sets (set A, B, C) of five pairs. The pre-measurement consists of 80 trials and includes set A and set B: both sets are shown in landscape and portrait format. The respondents will either receive the instruction to push the portrait format or to push the landscape format: this counterbalancing is done to eliminate biases due to potential differences due to the format. The training consists of 400 trials and includes set B and set C: the respondents in the 'push landscape' version of the pre-measurement will receive a training in which 90% of the pros of smoking will be shown in the 'push format (i.e. landscape format)'; the respondents in the 'push portrait' version will receive a training in which 90% of the pros of smoking are shown in the 'push format (i.e. portrait format)'. The pre-measurement starts with exercise trials in order to make the respondent familiar with the task. Both the pre-measurement and the training include priming blocks in which smoking related pictures are shown to introduce a smoking context among the respondents. The post-measurement consists of 80 trials and includes set A and set C: again, including untrained pictures (set A) and trained pictures (set C). Examples of the smoking related primes and the matched pro-con pictures are included in the additional electronic material.

4. Discussion

This paper describes the development of an implicit pictorial task aimed at exploring attentional and approach biases with regard to the pros and cons of smoking among smokers who are unmotivated to quit smoking. The developed VPT and AAT measurement and training tasks will be used in another study to assess cognitive biases (attentional and approach biases) with regard to the pros and cons of smoking and to modify these biases in order to influence the explicitly perceived pros and cons of smoking and consequently the motivation to quit smoking.

The matching procedure used in this study for non-smokers was built on comparisons with regard to multiple parameters (i.e. valence, arousal and complexity), following an earlier study about alcohol cue reactivity [26]. This method is supposed to diminish picture variation between the category of interest (i.e. the pros of smoking) and the reference category (the cons of smoking). Our results showed that the pictures representing the pros of smoking were rated as significantly more pleasant and that the pictures representing the cons of smoking were rated as significantly more exciting. Proper matching is, therefore, essential in order to prevent that smokers' attention is only drawn towards the pros of smoking because of their affective characteristics. A recent study on alcohol drinkers indicated that also perceptual dimensions such as color

can reduce the effect of alcohol-related content on attracting the attention of alcohol drinkers' [37]. Another finding of this study is that there were no gender differences with regard to the three parameters. This suggests that the ratings of the pros and cons of smoking with regard to valence, arousal and complexity is not gender specific and that the tasks do not need to be tailored on gender and that the same tasks can be used for males as well as females.

Although this study used an objective procedure for identifying and matching pictures for a new implicit pictorial task, there were some limitations. First, the study results were based on a relatively small sample of 33 respondents. Yet, the study results showed that this sample had enough power to point out statistical differences with regard to the parameters valence and arousal. Second, the sample consisted of smokers only. Inclusion of non-smokers could potentially provide insight into whether these ratings are smoker-specific. However, for the study purposes and for the development of the task for smokers who are unmotivated to quit smoking, this set up may be sufficient as it provides insight into the perceptions of smokers. Nevertheless, future research should also compare smokers to non-smokers. Third, it should be noted that women were – as common in (online) surveys – over represented in this study, which may influence the generalizability of the results. Yet, our program will be delivered online, so these results may be generalizable to the group of smokers (younger people and women) that we may research with this approach. Finally, based on the literature and the interviews with the smokers a range of important pros and cons of smoking were identified. However, some of the pros of smoking (being: nice taste; distraction/having something in hands; smokers' image) and cons of smoking (being: bad for taste; dependence; negative for others and shame) appeared to be too difficult to represent in a picture. Consequently, our implicit pictorial tasks will not cover all relevant smoking related pros and cons and the results of the training will need to be interpreted in this light. Further research is needed to gain insight into the possibilities to represent these items in pictures or in alternative representations, e.g. videos or words.

Aside from the limitations, the development of implicit pictorial tasks for exploring attentional and approach bias that may be underlying the perceived pros and cons of smoking can form an important step towards motivating smokers who are not motivated to quit smoking. In the Netherlands, the group of smokers who are unmotivated to quit smoking within six months is still very large (76% of the smokers) and targeting this group is essential in order to further decrease the smoking prevalence and the health and economic burden of smoking. The tasks developed in this study are innovative versions (as we target implicit biases towards pictures representing explicit cognitions (i.e. pros and cons of smoking) and not drug-related stimuli) of the current implicit tasks based on drug-related stimuli and further testing on their validity as well as their use in larger randomized controlled trials aimed at exploring the role of attentional and approach bias with regard to the perceived pros and cons of smoking among smokers who are not motivated to quit smoking is recommended.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.conctc.2016.10.004>.

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